TWR-77407
ECS SS12947

SPACE SHUTTLE PROGRAM
Space Shuttle Projects Office (MSFC)
NASA Marshall Space Flight Center, Huntsville, Alabama

Reusable Solid Rocket Motor

STS-112 Flight Readiness Review/CoFR

Motor Set RSRM-87

17 September 2002

Presented by Stan Graves

ATK THIOKOL PROPULSION

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Agenda

Flight Readiness Review/CoFR

1.0 Previous Flight Assessment—STS-111—**No Issues**

2.0 Certification Status—**No Constraints**

3.0 Changes Since Previous Flight

4.0 Configuration Inspection

- 4.1 As-Built Versus As-Designed, Hardware, and Closeout Photo Review Status—**No Issues**
- 4.2 Hardware Changeouts Since ET/SRB Mate Review—**None**

5.0 SMRB Nonconformances—**No Issues**

6.0 Technical Issues/Special Topics

7.0 Readiness Assessment

Backup LCC and Contingency Temperatures for STS-112

Previous Flight Assessment—STS-111

Disassembly Evaluation Summary—Status of Disassembly Activity

KSC Operations		LH RSRM	RH RSRM	Remarks
Initial LH/RH SRB viewing	*	Complete	Complete	No Issues
SRB/RSRM walkaround assessment	*	Complete	Complete	
Demate/evaluate aft exit cone (AEC)	*	Complete	Complete	
Remove/evaluate S&A and OPTs	*	Complete	Complete	
Remove/evaluate nozzle	*	Complete	Complete	
Remove/evaluate stiffener rings/stubs		Complete	Complete	
Remove/evaluate igniter	*	Complete	Complete	
Demate/evaluate field joints/evaluate insulation	*	Complete	Complete	
Utah Operations				
Disassemble/evaluate nozzle (joint No. 4 and 5)	*	Complete	Complete	No Issues
Disassemble/evaluate nozzle (joint No. 2 and 3)	*	Complete	Complete	
Disassemble/evaluate S&A	*	Complete	Complete	
Washout nozzle phenolics		Complete	Complete	
Washout nozzle AEC phenolics		19 Sep 2002	19 Sep 2002	
Measure/evaluate aft dome insulation		Oct 2002	Oct 2002	

* RSRM Project committed to complete prior to next launch

- No constraints to STS-112 flight

Changes Since Previous Flight

Supplier Process

SOCR V001794, Incorporate New Larger O-ring Spiral Cordstock Molds in Fabrication
Status: Approved

Change Description	Reason for Change	Basis of Verification
Increase size of spiral cordstock molds to make longer pieces of O-ring cordstock. Cordstock length increases from 20 to 40 feet	Longer pieces of cordstock reduce the number of, or eliminate, "in-process splices"	Similarity: New molds are identical to the previous molds (same material, thickness, spacing between grooves, groove depths, chrome plating, etc.) except for size and number of spiral coils Time, temperature, and pressure used in the molding process is unchanged. Temperature sensors across the platens of the new press allow for complete monitoring of cure temperatures Test: Material properties verification includes tensile strength, elongation, Shore A hardness, compression set, resiliency, and specific gravity—within family. TGA testing indicates expected O-ring erosion performance to be equivalent Inspection: Visual, dimensional, and x-ray inspection of finalized O-rings ensure acceptability STS-112 and subsequent are safe to fly

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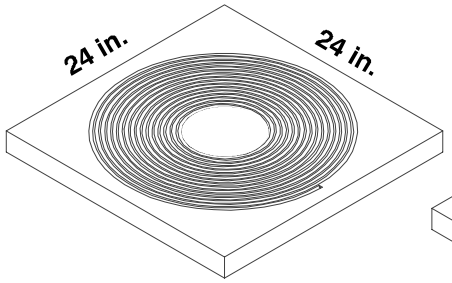

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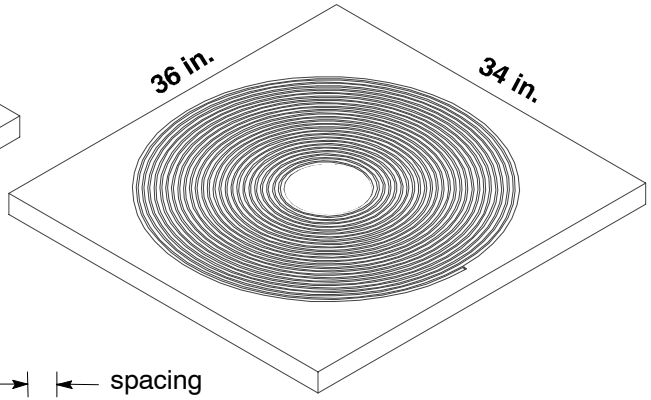

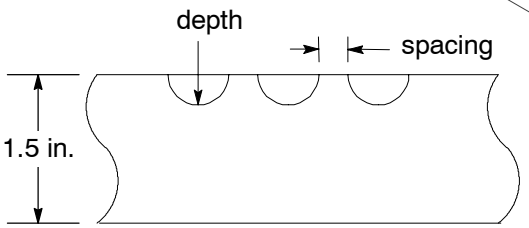

Technical Issues/Special Topics

X-ray Inspection of Igniters, Loaded Segments, and Nozzles

Observation

- Audit of archived x-ray film records in work for all RSRM hardware in inventory
  - 26,332 pieces of film per flight set (igniters—324, loaded segments—8272, and nozzles—17,736)
- STS-112 audit accounted for 26,311 pieces of required film (99.92 percent)
  - 16 pieces of missing film and five occurrences of incorrect film speed/exposure
  - Redundant exposures and overlaps fully screened all missing/incorrect film areas except three small regions
    - RH forward-center segment: 3.87-in. axial region in insulation at 219 deg
    - LH nozzle aft inlet ring: 0.25-in. zone near carbon-phenolic flame surface at 249 deg
    - RH nozzle aft inlet ring: 0.188-in. glass-phenolic zone at 63 deg

Concern

- Can defects of concern exist in the three regions with less than full x-ray coverage?
- Does film accountability issue indicate a problem with integrity of film read?

Technical Issues/Special Topics

X-ray Inspection of Igniters, Loaded Segments, and Nozzles (Cont)

Discussion

- Three regions analyzed with assumed worst-case defects that may not be detected by adjacent x-ray shots
  - Positive margins of safety for all cases using worst-case loads and material properties
  - All STS-112 process and material properties in-family, all other inspection results nominal (adjacent shots, alcohol wipe, etc.)
- Review of film read integrity identified no issues
  - Practitioner interviews—film read is clearly their focus
  - Intensive practitioner certification process and ongoing maintenance in-place
  - Every fifteenth part is independently re-reviewed on an ongoing basis—no issues
  - In excess of 1500 pieces of film independently re-read—no issues

Flight Rationale

- Structural and thermal analyses for assumed defects show positive margins
- All materials and processes are in-family: In-family performance expected
- STS-112 is safe to fly

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STS–112 Readiness Assessment

Pending satisfactory completion of normal operations flow (per OMRSD), the RSRM hardware is ready to support flight for mission

STS–112

17 September 2002

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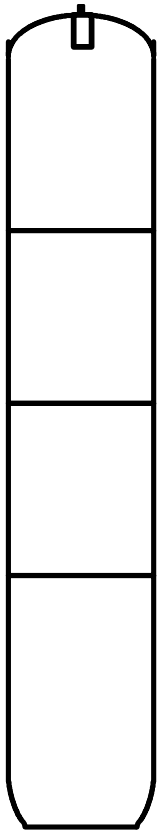
Current Flight Predictions

LCC and Contingency Temperatures for STS-112



Heater Location	LCC	Minimum Allowable Sensor Temperature*	
		LH	RH
Igniter	74°F	72°F	72°F
Forward Field Joint	86°F	65°F	69°F
Center Field Joint	86°F	71°F	70°F
Aft Field Joint	86°F	70°F	66°F
Nozzle-to-Case Joint	75°F	65°F	63°F

*LCC contingency temperature in the event of heater failure
Note: Calculation includes all standard repair conditions